Method for Achieving Low Defect Density AlGaN Single Crystal Boules

ABSTRACT OF THE DISCLOSURE

A method for growing bulk GaN and AlGaN single crystal boules, preferably using a modified HVPE process, is provided. The single crystal boules typically have a volume in excess of 4 cubic centimeters with a minimum dimension of approximately 1 centimeter. If desired, the bulk material can be doped during growth to achieve n-, i-, or p-type conductivity. In order to have growth cycles of sufficient duration, preferably an extended Ga source is used in which a portion of the Ga source is maintained at a relatively high temperature while most of the Ga source is maintained at a temperature close to, and just above, the melting temperature of Ga. To grow large boules of AlGaN, preferably multiple Al sources are used, the Al sources being sequentially activated to avoid Al source depletion and excessive degradation. In order to achieve high growth rates, preferably a dual growth zone reactor is used in which a first, high temperature zone is used for crystal nucleation and a second, low temperature zone is used for rapid crystal growth. Although the process can be used to grow crystals in which the as-grown material and the seed crystal are of different composition, preferably the two crystalline structures have the same composition, thus yielding improved crystal quality.

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